10/590758
IAP9 Rec'd PCT/PTO 25 AUG 2006

PCT/AT05/00060
ACC Austria GmbH
Text as originally filed

A refrigerant compressor

Background of the Invention

The present invention relates to a compressor for hermetically encapsulated small-type refrigerating machines according to the preamble of claim 1.

Description of the Prior Art

Compressors of this kind comprise in the known manner a cylinder with a cylinder housing and a piston guided in the piston bore of the cylinder for compressing a working medium, with the cylinder being sealed with a cylinder head. Bolted connections are usually used for fastening the cylinder head to the cylinder housing.

The use of bolted connections comes with the disadvantage however that as a result of the forces which are introduced via the bolts into the cylinder housing, the cylindrical shape of the cylinder bore is negatively influenced. Bolted connections further always lead to additional assembly work because the bores for the bolts need to be placed at first in a purposeful way in order to ensure optical centering of the cylinder head relative to the cylinder housing. It would also be advantageous to replace the punctiform contact pressure caused by the bolted connections by a contact pressure which is constant over the entire sealing surface, as a result of which the sealing surface could also be reduced. It would further be advantageous to provide the introduction of the forces of the fastening means for the cylinder head on the cylinder housing in such a way that it is made especially in such regions of the cylinder head in which the highest loads occur by the piston force. The cylinder can thus be protected.

Summary of the Invention

It is therefore the object of the present invention to fix the cylinder head to the cylinder housing in such a way that a

negative impairment to the cylindrical shape of the cylinder bore is prevented. It is a further object of the present invention to reduce the amount of work and material involved in mounting, such that the use of bolts is omitted. The ability to easily center the cylinder head relative to the cylinder housing shall be ensured. An even contact pressure and a reduction of the sealing surfaces and thus a lower force of pressure for sealing the sealing surfaces at a surface pressing that remains the same are thus necessitated, as a result of which deformations are lower. Moreover, the introduction of forces of the fastening means for the cylinder head on the cylinder housing shall be provided in such a way that it is made especially in such areas of the cylinder head in which the highest loads occur by the piston force in order to thus load the cylinder head in a minimal way.

Solution to the Object

These objects are achieved by the characterizing features of claim 1.

Claim 1 provides that a fastening element is provided which fastens the cylinder head to the cylinder housing by a contact pressure exerted in the region of the axis of the piston bore. According to claim 2, it concerns a clamp which fastens the cylinder head to the cylinder housing. According to claim 3, the clamp comprises a base part and lateral parts, with the base part being arranged in the axial direction before the cylinder head and a contact pressure is exerted on the cylinder head in the axial direction with the help of the base part, and the lateral parts are anchored fixedly relative to the cylinder housing. The base part of the clamp is appropriately chosen so wide that it fixes the cylinder head with an even contact pressure on the cylinder housing. Claim 4 provides as a special configuration that the lateral parts are formed as laterally projecting, resilient legs with end parts bent in a substantially L-shaped manner, with the base part resting on the cylinder head and the anchoring of the lateral parts relative to the cylinder housing occurring by way of a latching of the end regions of the

resilient legs. According to claim 5, the clamp is provided with a substantially U-shaped configuration. It would also be possible to provide several legs. According to claim 6, the base part is provided with configuration which is arched in the direction of the legs, which thus increases the pressure resilience of the base part.

The latching can be realized in different ways. According to claim 7, the latching occurs with the help of bearing blocks which are rigidly connected with a supporting part of the compressor, with the bearing blocks each having at least one edge which are encompassed at least partly by the end regions of the legs.

According to claim 8, it is provided for forming a latching that the clamp encompasses the entire cylinder housing, with the cylinder housing having edges which are encompassed at least partly by the end regions of the legs. The use of bearing blocks can thus be omitted. According to claim 9, the latching is formed with the help of grooves in the cylinder housing. One end region of the legs engages into each of the grooves.

The base part of the clamp need not rest directly on the cylinder head. It is provided for according to claim 10 that the base part guides a pressing screw which exerts a contact pressure on the cylinder head in the axial direction. It is provided in accordance with claim 11 however that the base part rests directly on the cylinder head and the lateral parts are anchored to bearing blocks fixedly joined to a supporting part of the compressor, with at least one of the lateral parts being configured as a screwed connection between base part and bearing block. In both variants is it possible to achieve a variable contact pressure of the cylinder head on the cylinder housing by a changed tightening of the screw.

Claim 12 provides an alternative embodiment of the fastening element in accordance with the invention, in which the fastening element is arranged as a locking clip. According to claim 13, the

fastening element is arranged as a fastening element which exerts a tensile force and rests on the cylinder head and is fixed relative to the cylinder housing. It can especially concern a rope or a wire.

Claims 14 to 19 finally relate to the advantageous possibilities for fastening the valve plates of the cylinder head to the cylinder housing within the scope of using a clamp in accordance with the invention. According to claim 20, the contact pressure exerted by the fastening element in the area of the axis of the piston bore corresponds to an axial force of pressure of 1000 N to 10000 N, preferably 3000 N.

The invention is now explained in closer detail by reference to the enclosed drawings, wherein:

Fig. 1 shows a perspective view of a first embodiment of the relative arrangement of cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp;

Fig. 2 shows a perspective view of the arrangement according to Fig. 1 from another angle;

Fig. 3 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp;

Fig. 4 shows a perspective view of the arrangement according to Fig. 3 from another angle;

Fig. 5 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp;

Fig. 6 shows a perspective view of the arrangement according to Fig. 5 from another angle;

Fig. 7 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp, in which the base part of the clamp does not rest directly on the cylinder head;

Fig. 8 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp, in which the base part of the clamp does not rest directly on the cylinder head;

Fig. 9 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp, in which the base part of the clamp rests directly on the cylinder head, and a variable contact pressure of the cylinder head on the cylinder housing can be achieved by a screwed joint between base part and a bearing block;

Fig. 10 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, valve plate and cylinder housing which shows a possibility for fixing the valve plate in the cylinder housing;

Fig. 11 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, valve plate and cylinder housing;

Fig. 12 shows a sectional view through the arrangement according to Fig. 10;

Fig. 13 shows a sectional view through the arrangement according to Fig. 11;

Fig. 14 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a locking clip which is fixed by means of the holding pin;

Fig. 15 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention whose lateral parts are formed on the cylinder housing and define an opening in the region of the axis of the piston bore into which a rigid base part and one or several springs are inserted;

Fig. 16 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a locking clip whose T-shaped end regions latch into the bearings formed by the two bearing blocks;

Fig. 17 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp which is fixed by means of two holding pins;

Fig. 18 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a clamp which is fastened to the bearing blocks by means of two screws;

Fig. 19 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a locking clip, with one end of the locking clip being fixedly screwed onto a bearing block;

Fig. 20 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as an elastically bendable fastening element in the form of a rope or wire.

Fig. 21 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a locking clip which is fixed by means of a further embodiment of a holding pin;

Fig. 22 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, cylinder housing and the fastening element in accordance with the invention which is arranged as a locking clip which is fixed by means of a clamping element;

Fig. 23 shows a perspective view of a further embodiment of the relative arrangement of the cylinder head, valve plate and cylinder housing in which a locking body is provided;

Fig. 1 shows a perspective view of a first embodiment of the relative arrangement of cylinder head 1, cylinder housing 4 and the fastening element in accordance with the invention which is arranged as a clamp 2. The individual components are merely shown schematically. Accordingly, cylinder head 1 will be usually arranged as a module which especially comprises a valve plate (not shown in the Figs. 1 to 9 and 14 to 22). Such a module is also included below in the term "cylinder head". It is merely relevant for the understanding of the present invention that the cylinder head 1 comprises a face surface 10 as a contact surface to the cylinder housing 4 and to the valve plate 16, and a pressing surface 11 as a contact surface to the base part 5 of clamp 2. A piston (not shown in Figs. 1 to 22) for compressing a working medium is guided within the cylinder housing 4.

The cylinder head 1 can rest on the valve plate 16 or it can encompass the same entirely. In the first case it is obviously clear that a contact pressure exerted by the clamp 2 on the cylinder head 1 is transmitted directly onto the valve plate 16 and presses the same against the cylinder housing 4. In the second case, webs 21 will be provided within the cylinder head 1 which rest on the valve plate 16 and ensure a transmission of the contact pressure exerted by clamp 2. Such webs 21 can also be provided when the cylinder head 1 rests on the valve plate 16, as is shown in Fig. 13 for example. Notice shall be taken that the valve plate 16 is not shown directly in Figs. 1 to 9 and 14 to 22, but it is obviously provided. It is encompassed completely according to the illustrations in Figs. 1 to 9 and 14 to 22, so that it is not visible in these illustrations. Figs. 10 and 11 on the other hand show an exploded view in which the valve plate 16 is visible. The shape and centering of the valve plate 16 in the cylinder housing 4 will be described at a later point. The fixing of the valve plate 16 relative to the cylinder housing by means of the clamp 2 will be described first in closer detail.

In accordance with the invention, the fixing of the cylinder head 1 occurs relative to the cylinder housing 4 by means of a clamp 2. The clamp 2 comprises in one embodiment a base part 5 and laterally projecting resilient legs 6, with the base part 5 being provided with an arched configuration in the direction of legs 6 according to a preferred embodiment. This increases the flexural stiffness and thus the pressure resistance of the base part 5. In the mounted state, the base part 5 is aligned with respect to the cylinder head 1 in such a way that the arching of the base part rests with its convex side on the cylinder head 1. The base part 5 of the clamp 2 will be chosen in an appropriate manner with such a width that it fixes the cylinder head 1 with even contact pressure on the cylinder housing 4.

According to the embodiments shown in Figs. 1 to 6, the clamp 2 comprises two legs 6 and is thus provided with a substantially U-shaped configuration. It would also be possible that the clamp 2 comprises several legs 6. The legs 6 are preferably arranged in

such a way that they are suitable for latching. This is achieved in the embodiment of the compressor in accordance with the invention in such a way that the end regions 7 of the legs 6 are provided with a substantially L-shaped configuration, as will be explained below in closer detail.

According to the embodiment of Fig. 1, bearing blocks 3 are further provided, with the bearing blocks 3 each comprising at least one edge 12 which is encompassed at least partly by the end regions 7 of the legs 6, so that the clamp 2 hooks into the bearing blocks 3 and thus forms a latched connection ensuring a secure anchoring of the lateral parts 6. The type of latched connection is shown especially well in Fig. 2. The bearing blocks 3 can be attached to the cylinder housing 4, but can also be arranged as separate components, as is indicated in Fig. 1. The bearing blocks 3 are not fastened to the cylinder housing 4 but to a support part 9 which is a part of the compressor and is arranged in such a way that a reliable latched connection of the clamp 2 is ensured and thus a secure fixing of the cylinder head 1 relative to the cylinder housing 4. The use of the bearing blocks 3 also uncouples the introduction of force for fixing the cylinder head 1 relative to the cylinder housing 4 from the cylinder bore.

A further embodiment of the latched connection is shown in Figs. 3 and 4. For forming a latched connection it is provided in this case that the clamp 2 encompasses the entire cylinder housing 4, with the cylinder housing 4 comprising edges 13 which are encompassed at least partly by the end regions 7 of the legs 6. The use of bearing blocks 3 can thus be omitted. The type of latched connection within the framework of this embodiment is shown especially clearly in Fig. 4. A secure anchoring of the lateral parts 6 is also ensured in this manner.

Figs. 5 and 6 show a further embodiment of the latched connection. The latched connection is formed here with the help of grooves 8 in the cylinder housing 4 into which engage an end section 7 each of the legs 6. The embodiment in accordance with Fig. 15 is

comparable, where the lateral parts 6 are fixed to the cylinder housing 4 and form an opening in the region of the axis of the piston bore. The base part 5 can be inserted into this opening with the help of a groove and spring system, with the base part 5 being arranged as a rigid element.

Fig. 7 shows an embodiment of a clamp 2 in which the base part 5 does not rest directly on the cylinder head 1, but a pressing screw 14 is provided for axially introducing the forces. The pressing screw 14 is guided by the base part 5, with the base part 5 being provided with a respective counter-thread in the guide region. Any tightening of the pressing screw 14 thus produces an increasing contact pressure of the cylinder head 1 on the cylinder housing 4 as a result of the secure fixing of the lateral parts 6 of the clamp 2. The contact pressure can thus be varied. As is also shown in Fig. 7, the clamp 2 is not provided with a U-shaped configuration in such an embodiment. Instead, it is provided with a V-shaped configuration. Fig. 16 shows a similar embodiment, in which the base part 5 of the clamp 2 rests directly on cylinder head 1.

An embodiment comparable to Fig. 7 is also shown in Fig. 8. Merely the type of anchoring of the lateral parts 6 on the bearing blocks 3 is different. According to Fig. 8, the bearing blocks 3 each comprise slots which cross the respective bearing block 3 and are used for receiving a lateral part 6. The anchoring of the lateral parts 6 can further be improved by the L-shaped bent end sections 7 of the lateral parts 6.

A further embodiment of the fastening element in accordance with the invention is shown in Fig. 18. In this case, the lateral parts 6 of clamp 2 are fastened by screws 28 directly to the bearing blocks 3.

Fig. 9 shows a perspective view of a further embodiment of the relative arrangement of cylinder head 1, cylinder housing 4 and the clamp 2 in accordance with the invention, in which the base part 5 of clamp 2 rests directly on cylinder head 1. A lateral

part 6 is arranged as a bolted connection 15 between base part 5 and a bearing block 3, thus achieving a variable contact pressure of the cylinder head 1 on the cylinder housing 4.

Instead of the bolted connections 15 it would also possible to provide hook-like connections, as are shown in Fig. 17 for example. The connection is established here by holding pins 26 with heads 27 on the end side which on their one side hook into a slot crossing the bearing block 3 and on their other side hook into a respective slot in the lateral part 6 of clamp 2.

A further embodiment of the fastening element in accordance with the invention is shown in Figs. 14, 19, 21 and 22. The fastening element is arranged here as a locking clip 24 which latches into a bearing 29 arranged on the bearing block 3 and is subjected to force on the other side by a tensile connection. Fig. 19 clearly shows how the end section of a lateral part 6 is provided with a T-shaped configuration and latches into a bearing 29. The other lateral part 6 is screwed onto the second bearing block 3 by means of a screw 28. In Fig. 14 on the other hand, the second lateral part 6 is fastened by means of a holding pin 26 (as described on the basis of Fig. 17) to bearing block 3. As is shown in Fig. 21, the fastening of the second lateral part 6 can also occur by means of a slightly modified holding pin 26 in which an end section comprises a cross bolt 30 which is held in a respectively concave-shaped end section 31 of a lateral part 6 of clamp 2. Fig. 22 finally shows an embodiment of a locking clip 24 in which a clamping element 32 is received by respective concave-formed end section 31 of a lateral part 6. The clamping element 32 is fastened to a bearing block 3.

Fig. 20 finally shows an embodiment of the fastening element in accordance with the invention in which it is configured as an elastically bendable fastening element 25 such as a rope or wire 25. The rope or wire 25 is clamped between the bearing blocks 3, with the cylinder head 1 being provided with a groove 31 diametrically traversing the same in which the rope or wire 25 is

placed for the purpose of better guidance of the rope or wire. The rope 25 can be a steel cable 25.

The valve plate 16 as mentioned above (not shown in Figs. 1 to 9 and 14 to 22) is usually a component of the module designated here as cylinder head 1 and is usually fastened to the cylinder housing 4 by means of bolted connections. The face surface 10 of the cylinder head 1 encompasses this valve plate 16 and rests on the valve plate 16. Since bolted connections are omitted in the fastening of the cylinder head 1 in accordance with the invention to the cylinder housing 4, it is advantageous to also fasten the valve plate 16 to the cylinder housing 4 without using bolted connections. This can be achieved in such a way for example that the valve plate 16 is sunk at least partly in a step-like bore 17 in the cylinder housing 4. If the valve plate 16 is provided with a disk-like configuration, a radial nose 18 of the valve plate 16 can be provided which engages in a respective radial notch 19 in the cylinder housing 4 and prevents any twisting of the valve plate 16 in the step-like bore 17 (Fig. 10). As an alternative to this, the valve plate 16 can also be provided with a radial notch in which a radial projecting nose of the cylinder housing 4 engages.

Such a twisting of the valve plate 16 in the step-like bore 17 during the operation of the compressor can also be prevented without such a nose 18 and without a notch. As is indicated in Fig. 11, the cylinder head 1 can also comprise a recess 22 for receiving a muffler (not shown in Fig. 11) for example. The muffler arranged here can be shaped in such a way that it partly engages in a bore 20 of the valve plate 16, so that any twisting of the valve plate 16 is prevented again. Fig. 11 further shows packing disks 23.

Fig. 12 shows a sectional view of the arrangement of cylinder housing 4, valve plate 16 and cylinder head 1 according to the embodiment of Fig. 10. This shows especially that the face surface 10 of the cylinder head 1 rests on the valve plate 16 and is also partly sunk in the step-like bore 17. Fig. 13 shows a

sectional view of the arrangement of cylinder housing 4, valve plate 16 and cylinder head 1 according to the embodiment of Fig. 11. It is shown in particular that the cylinder head 1 can comprise webs 21 which ensure additional contact pressure of the cylinder head 1 on the valve plate 16.

Fig. 23 shows a perspective view of a further embodiment of the relative arrangement of cylinder head 1, valve plate 16 and cylinder housing 4, in which a locking body 34 is provided. The valve plate 16 as well as the cylinder housing 4 each comprise a radial notch 35, 36 into which a locking body 34 can be inserted with radial alignment of the notch 35 of the valve plate 16 with the notch 36 of the cylinder housing 4. The locking body is shown in Fig. 23 as an oblong, rod-like element 34. Other embodiments are possible insofar as they prevent a twisting of the valve plate 16 or the cylinder head 1 in the cylinder housing 4. Moreover, the cylinder head 1 can also comprise a radial notch 37 into which the locking body 34 can be inserted in case of overlapping alignment of the notch 35 of the valve plate 16 with the notch 37 of the cylinder head 1.

The introduction of force or the contact pressure of the fastening elements 2, 24, 25 in accordance with the invention for the cylinder head 1 on the cylinder housing 4 is carried out in these embodiments in such a way that it is made especially in such regions of the cylinder head 1 in which the highest loads occur by the piston force, i.e. in the area of the axis of the piston bore. The way how this contact pressure of the fastening element 2, 24, 25 is produced by its different components is illustrated in Figs. 14 to 22 by the entered force vectors. The contact pressure exerted by the fastening element 2, 24, 25 in the region of the axis of the piston bore corresponds preferably to an axial contact pressure of 1000 N to 10000 N, preferably 3000 N.

As is shown in the Figs. 1 to 23, it is ensured with the embodiment of a compressor in accordance with the invention that the cylinder head 1 can be fixed on the cylinder housing 4

without any impairment to the cylindrical shape of the cylinder. Furthermore, the amount of mounting work and material is reduced because the use of screws can be avoided. An easy centering capability of the cylinder head 1 relative to the cylinder housing 4 is ensured and an even contact pressure of the cylinder head 1 on the cylinder housing 4 and a reduction of the sealing surface 10 is enabled. Furthermore, the introduction of force of the fastening element for the cylinder head 1 on the cylinder housing 4 is produced in such a way that it is made especially in such areas of the cylinder head 1 in which the highest loads occur by the piston force. The cylinder head 1 is thus protected in the best possible way and can also be provided with a smaller configuration. The fastening of the cylinder head 1 on the cylinder housing 4 is thus also easily detachable and nevertheless represents a secure closure of the cylinder.